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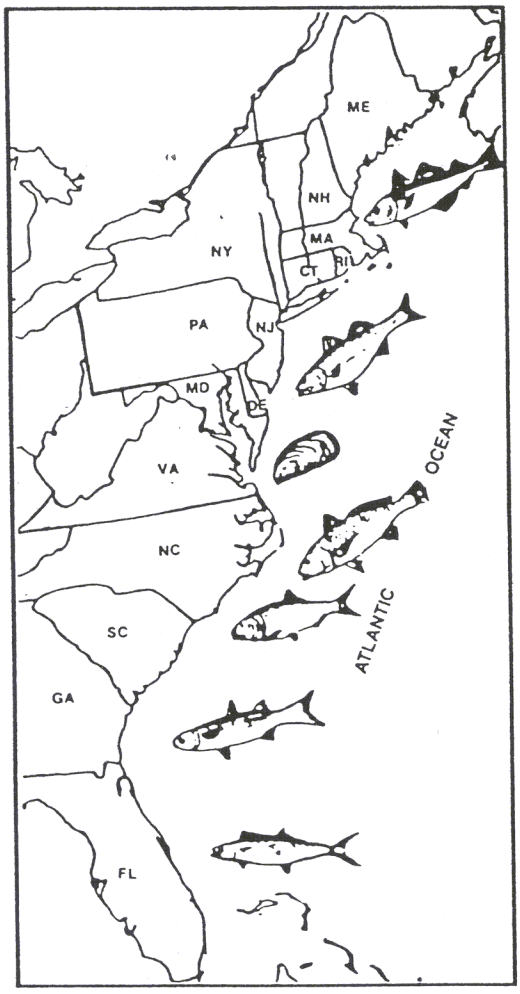
ATLANTIC STATES MARINE FISHERIES COMMISSION



SUPPLEMENT TO THE STRIPED BASS FMP- AMENDMENT #4

October 1989

SUPPLEMENT TO THE
ASMFC STRIPED BASS
FISHERIES MANAGEMENT PLAN -
AMENDMENT #4

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EXECUTIVE SUMMARY

This amendment to the ASMFC Interstate Striped Bass Management Plan became effective upon its adoption by the Commission October 4, 1989. The recommendations and management actions specified in this Amendment supercede all previous and existing management regimes. Implementation is required because the trigger mechanism specified in Amendment 3 of the plan was achieved in 1989. The trigger for action was that the Maryland young-of-year striped bass index exceeded a three-year running average of 8.0. Regulations under Amendment 3 lapsed when the trigger value was reached. Management regimes included in this plan will be implemented in the near future.

The primary goal of this plan is conservation and preservation of the East coast migratory stocks of striped bass (Figure 1). The plan is not intended to maximize yield from these stocks, and decisions on allocation of harvest among user groups are left to individual states.

An adaptive management approach will be employed in implementing this plan. Management measures will be identified, based on the best data and information available, which are intended to achieve certain management objectives. Stocks and fisheries will be rigorously monitored when fisheries are initiated, and management measures will be changed on a regular basis if management objectives are not being met.

A Striped Bass Technical Committee, composed of fisheries biologists from each coastal state from Maine to North Carolina, the District of Columbia, the Potomac River Fisheries Commission (PRFC), and two federal agencies, (National Marine Fisheries Service, U.S. Fish and Wildlife Service) will have responsibility for reviewing monitoring data and fisheries information to assess whether management targets are being met and whether stocks are in a restored or depressed status. Management actions regarding changes in management targets or actions will be subject to approval by the ASMFC Policy Board, made up of fisheries administrators from each coastal state.

The plan is intended to be flexible and responsive to changes in stock and fishery status. Target fishing rates (represented by "F") have been identified, using computer models and statistical analyses, which will allow certain levels of harvest while still permitting striped bass populations to grow or maintain a certain stock level.

A transition management regime will be implemented when the Amendment 3 young-of-year index trigger is reached. The target F during transition will be 0.25, which will allow a low level of harvest and at the same time permit striped bass stocks to grow

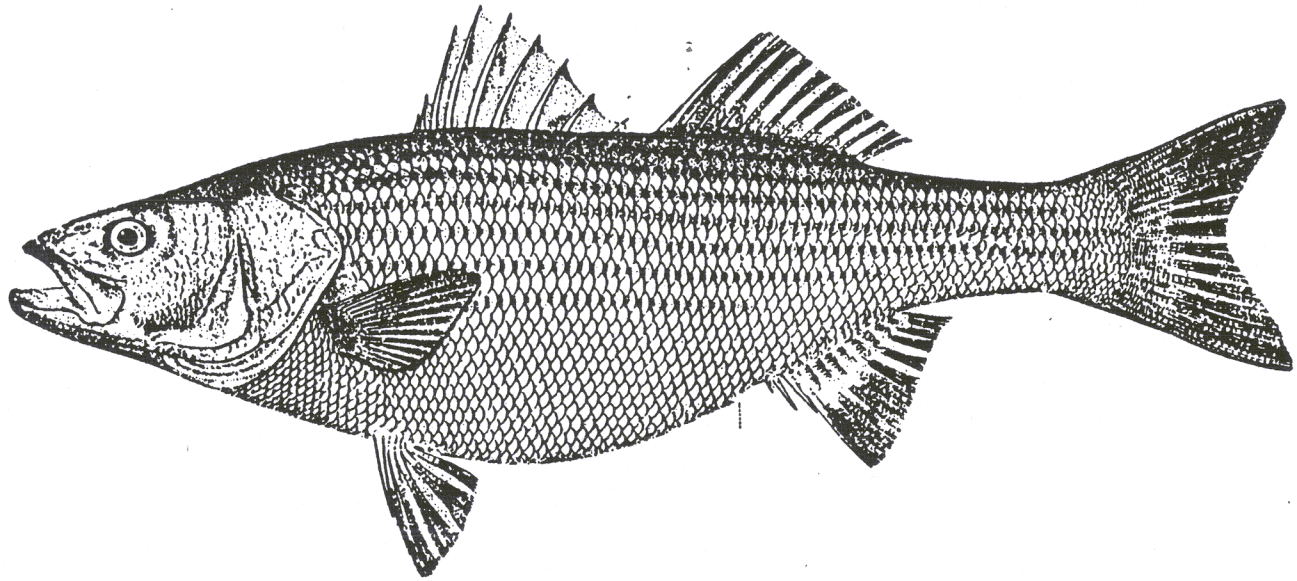

Figure 1. Striped bass, Morone saxatilis (from Bigelow and Schroeder 1953)

at a relatively rapid rate. After stocks have reached a restored status, the target F will be increased to 0.5, which will permit greater harvest but still allow the stocks to maintain themselves at restored levels.

The preferred alternative management measures to be implemented during the transition regime are presented in Table 8.2 of this document (see page 32). Preferred alternative management measures for the long-term management regimes will be developed at a later date and will be based on then current information on fisheries and stock status gained from monitoring during the transition regime.

For both the transition and long-term regimes, combinations of size limits, seasons and bag limits will be the primary management measures employed to attain the target fishing rates. States are permitted to propose alternative approaches, such as quotas, which are then reviewed for technical adequacy and accepted or rejected by ASMFC.

Fishing rates will be monitored closely. If actual fishing rates are higher than target values, regulations will be made more restrictive. If rates are lower than target values, regulations may be made less restrictive. Because the management regimes to be implemented are based on analyses of old data and information, it is possible that fishing rates during the transition regime will be higher than the intended rate. If so, transition management measures may have to be made more restrictive, in order to ensure that stocks will continue to grow toward a fully restored status.

Stock status will also be monitored closely. State monitoring plans must be approved by the existing S&S Committee and Management Board, and implemented before the state can institute management regimes specified in this plan. Primary population characteristics to be monitored include reproductive success (as indicated by young-of-year abundance) and various characteristics of the adult stock (e.g., age composition of the spawning stock). Poor reproductive success or significant adverse changes in adult stock characteristics will trigger a reassessment of the suitability of the target fishing rates. Such a reassessment could result in a conclusion that the target fishing rate should be lowered, which in turn could result in harvest regulations being made more restrictive. This circumstance could arise, for example, if reproductive success is adversely affected by some type of environmental degradation unrelated to fishing mortality. In such an instance, fishing mortality may have to be reduced in order to ensure the preservation of adequate stock for full recovery when current environmental problems are corrected.

At the present time, the Maryland juvenile index is the single measure of reproductive success being used to guide management. This plan will incorporate juvenile indices for other coastal stocks into the managment process when those indices are validated to the satisfaction of the Striped Bass Technical Committee. Figure 2 presents the overall adaptive management scheme for the ASMFC interstate striped bass management program.

Striped bass stocks cannot persist, regardless of restrictions on fisheries, without having available adequate habitat and good water quality. These habitat and water quality requirements are stressed in a series of recommendations in this plan dealing with the establishment of water quality criteria for striped bass spawning and nursery areas, the introduction of contaminants into striped bass habitat, the detailed review of permit applications for facilities which might impact striped bass stocks, and the careful screening of water withdrawal projects which might affect various life stages of striped bass.

Because of the socioeconomic importance and desireability of striped bass, many hatchery and stocking programs are underway along the coast. Improper conduct and implementation of such programs could adversely affect native coastal stocks of striped bass. This plan includes a series of recommendations aimed at protecting the genetic integrity of native coastal stocks, preventing the potential introduction of striped bass hybrids into coastal waters and providing guidelines to ensure coordination of existing programs and minimizing the probability of adverse impacts, such as disease introduction. Recommended priorities for research studies of striped bass stocks are also presented here.

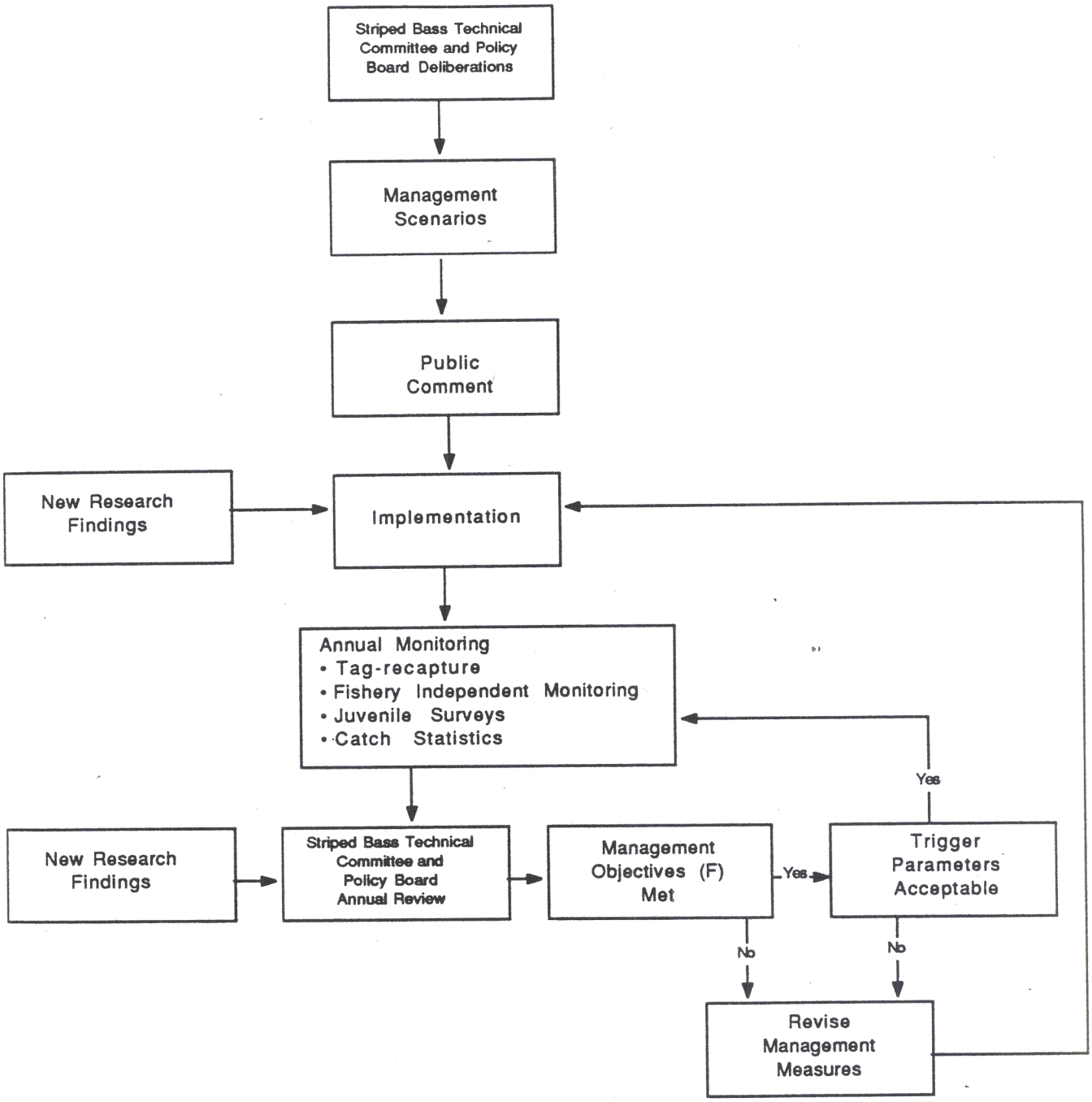

Figure 2. Adaptive management scheme for the ASMFC interstate striped bass management program

FOREWORD

This plan amendment was prepared by Dr. William A. Richkus, of Versar, Inc., working under Contract 8835SBFP from the Atlantic States Marine Fisheries Commission, under the direction of the ASMFC Striped Bass Scientific and Statistical Committee (Chairman, Randall Fairbanks) and Management Board (Chairman, Philip Coates). Funding for this effort has been provided by USFWS, NMFS, and the Maryland Department of Natural Resources. Mr. Paul Perra of ASMFC served as contract administrator. Extensive support and input required for preparation of this document were provided by state and federal agency representatives on the S&S Committee. Extraordinary technical support in modeling and analysis was provided by Drs. Paul Rago and Robert Dorazio, USFWS, and Dr. Victor Crecco, Connecticut Department of Environmental Protection.

Support for development of this striped bass plan amendment was provided by the following grants:

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ASMFC/NMFS	Interjurisdictional Fisheries NA-88-EAH-00026
ASMFC/FWS	Striped Bass Management Planning No. 14-0009-86-921
ASMFC/FWS	Striped Bass Cooperative Agreement No. 14-16-0009-85-917
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ASMFC/MD	Striped Bass Management Planning F136-88-008
ASMFC/MD	Striped Bass Management Planning F172-89-008
ASMFC/FWS	Striped Bass Management Planning 14-0009-86-921

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1. INTRODUCTION

This document constitutes Amendment 4 of the Atlantic States Marine Fisheries Commission Interstate Striped Bass Management Plan, which was issued in 1981. Management actions specified in this document replace and supercede all previous and existing management measures implemented under the original plan and its prior amendments. The schedule for implementation of this plan is presented in Section 13, Plan Implementation.

The material presented here is based on analyses and deliberations of the ASMFC Striped Bass Scientific and Statistical (S&S) Committee and the ASMFC Striped Bass Management Board which have taken place over the past 3 years. These bodies include representatives from each coastal state from Maine to North Carolina, the District of Columbia, and the Potomac River Fisheries Commission (PRFC) as well as two federal agencies (United States Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS)). Appendix A presents listings of committee and board members. A Striped Bass Stocking Subcommittee was also established by ASMFC as part of the overall striped bass management program. That committee addressed all concerns about stocking which were identified by participating states and prepared a report summarizing their deliberations (Parker and Miller, 1986). That report also included recommendations intended to ensure that all striped bass stocking was done in a manner which would minimize conflict among programs and minimize the likelihood that there would be adverse consequences from any of the stocking efforts. Their findings served as the basis for Section 9 of this plan.

The scientific data and analyses upon which this ASMFC Interstate Striped Bass Management Plan is based are presented, for the most part, in the Striped Bass Management Plan Source Document (ASMFC 1989). An additional source of information relating to plan development is the series of minutes of S&S Committee and Management Board meetings which took place during plan development. Copies of these minutes are available from ASMFC.

This document includes twelve sections, each dealing with a specific aspect of the plan, as follows:

Section 2 - Management Plan Goal and Objectives - developed at the initial meeting of the S&S Committee and Management Board in 1986; the goal and objectives set the framework within which the management approach was constructed; the

Section 3 - Fishery Management Program - a general overview of the adaptive management approach taken in this plan and the identification of target fishing rates believed necessary to provide for stock growth and maintenance; management measures, selected to achieve management targets and objectives, will be reexamined and changed on a regular basis if targets and objectives are not met.

Section 4 - Management Plan Young-of-Year Index Triggers - a description of the manner in which annual estimates of juvenile abundance, representing a measure of reproductive success in a given year, will be used to determine if changes in management measures are needed, and where those management measures should be applied.

Section 5 - Management Plan Adult Stock Triggers - a description of characteristics of adult striped bass stocks which will be used to determine if stock status has changed; changes in stock status may result in changes in management measures.

Section 6 - Fisheries Harvest Regulations - a discussion of the types of management measures which will be used to achieve management plan targets and objectives; measures addressed include spawning ground fishing restrictions and size limits.

Section 7 - Monitoring Program - a description of fisheries and stock monitoring which must be conducted by individual state and federal agencies in order to ensure success of this management plan.

Section 8 - Preferred Management Alternatives - a presentation of harvest regulations which will be established upon implementation of this plan; measures include seasons, bag limits, and size limits.

Section 9 - Stocking - a description of steps which must be taken to ensure that native coastal striped bass stocks are not adversely affected by stocking programs.

Section 10 - Habitat and Water Quality Requirements - a presentation of steps which must be taken to ensure that habitat and water quality are maintained at levels which will continue to sustain healthy striped bass stocks.

Section 11 - Research Needs - a discussion and prioritization of research needs relative to current striped bass management.

Section 12 - Institutional Requirements - a description of the organizational structure which will guide implementation of this plan.

Section 13 - Plan Implementation - a description of the schedule and requirements for plan implementation.

This plan specifies both Management Actions and Recommendations. Management Actions are mandatory requirements of the plan. Those relevant to individual states must be implemented in order that the state be considered in compliance with provisions of this plan. Management Actions deal primarily with fisheries regulations and monitoring, as well as administrative aspects of plan implementation. Recommendations deal with issues which are of great importance to striped bass protection and enhancement but those which are not interpreted as being compliance requirements from the perspective of the Atlantic Striped Bass Conservation Act as renewed in 1988.

Acronyms used in this document are identified in Appendix B. Definitions of several important terms and phrases used here are presented in Appendix C.

2. MANAGEMENT PLAN GOAL AND OBJECTIVES

Goal: To perpetuate the striped bass resource throughout its range so as to generate optimal social and economic benefits to the nation from its commercial and recreational harvest and utilization over time.

Objectives:

1. To restore and maintain self-sustaining spawning stocks, minimizing the possibility of recruitment failure, as determined by YOY indices, or other measures of spawning success

2. Promote fair allocation of any allowable harvest among various components of the fishery

3. Adopt standards of environmental quality necessary for the maximum natural production of striped bass and for the utilization of allowable harvest

Management Unit: All coastal striped bass stocks of the east coast of the United States north of South Carolina

3. FISHERY MANAGEMENT PROGRAM

The approach taken in development of this revised striped bass management plan is based on the concept of adaptive management. Adaptive management inherently takes into account the fact that existing information and data available on the species being managed is often incomplete or inaccurate. In the face of such uncertainty, management regimes are developed based on the best information available, and the consequences of implementation of those regimes are closely watched through rigorous monitoring of the fishery and stock. New information collected via this monitoring is then analyzed, and the results of the analyses are used to modify the initial management approach. Monitoring is a continuous, permanent element of an adaptive management approach, as is the modification, correction or tuning of the management regimes implemented. This overall approach is intended to be flexible and capable of rapidly responding to changes in the status of stocks and the nature of the fisheries impacting those stocks.

Conceptual Basis

The following represent the major elements of the conceptual basis for the new management program:

- The revised ASMFC management plan will come into effect when the Maryland Chesapeake Bay striped bass juvenile index of abundance reaches a 3-year running average of 8.0 (Plan Implementation is discussed in Section 13)

- The revised plan will be based on adaptive management; regulations will be regularly reviewed (annually or biannually) and revised as needed to achieve management objectives

- Management will be based on target fishing rates (symbolized by the letter F); F represents the rate at which fish are removed from populations by fishing activities; target fishing rates are those which will allow stocks to grow and sustain themselves

- Changes in regulations may be triggered as a result of decreases in reproductive success as measured by juvenile indices, spawning stock age composition, and of fishing rates being higher or lower than the targeted rates.

Each of these major plan elements is addressed in detail in subsequent sections of this document.

Target Fishing Rates

Mortality of fish is generally partitioned into several categories: fishing mortality (represented by the letter F), which encompasses those fish removed from the population by commercial and/or recreational fishermen; and, natural mortality (represented by the letter M), which encompasses those fish lost from the population due to natural causes. Additional losses of fish may occur due to catch and release mortality and/or illegal bycatch of the species in fisheries targeting a different species.

Acceptable fishing rates were determined through statistical analysis and mathematical modeling of all east coast striped bass populations. Details of the modeling and analysis conducted to establish appropriate fishing rates are presented in the ASMFC Interstate Striped Bass Management Plan Source Document (ASMFC 1989).

Data on juvenile production, commercial harvest, migration rates, natural mortality rates, age of sexual maturity and other biological characteristics of the fish stocks were used to model and predict the rate of population growth and/or the amount of harvest which would occur under different fishery management regimes.

Results of such analyses lead to the conclusion that it would be possible to implement a limited, transition fishery when the Amendment 3 trigger was reached, which would allow some harvest of fish while still allowing the population to grow to fully restored status. The fishing rate selected for such a transition period was determined to be 0.25, equivalent to about 20% of the legal sized fish being harvested and 16.1% being lost to natural mortality.

For a fully restored, healthy population, the analysis and modeling revealed that stocks could sustain a fishing rate of 0.5 and still be maintained at restored levels. This fishing rate is equivalent to 36% of legal sized fish being harvested and 14.4% being lost to natural mortality. Analyses have shown that fishing rates between 0.75 and 1.0 with small size limits previously in effect resulted in stock collapse. Other analyses have suggested that historical fishing rates may have been on the order of 0.8 to 1.0.

Management Action 1. ASMFC interstate management of striped bass will be applied using an adaptive management approach, with harvest regulations being regularly reviewed and modified, if necessary, to attain target fishery rates (F); target rates are subject to change if stock status indicators suggest that they do not meet management objectives.

Management Action 2. Two instantaneous fishing rates will serve as target values for this management program; during the transition regime, while stocks continue to rebuild, the target fishing rate will be F=0.25 (the total mortality of legal size fish will be approximately 36% each year); during the long-term regime, when stocks are fully restored, the target fishing rate will be F=0.50 (the total mortality of legal size fish will be approximately 50% each year); regulations will be changed incrementally in moving from the transition to the long term regime to ensure that target fishing rates are not exceeded; evaluation of whether management targets have been met and determination of actions which need to be taken will be made by the ASMFC Striped Bass Technical Committee, and Interstate Fisheries Management Program (ISFMP) Policy Board.

4. MANAGEMENT PLAN YOUNG-OF-YEAR INDEX TRIGGERS

The revised management plan will take effect upon attainment of the juvenile index trigger identified in Amendment 3 of the current ASMFC management plan. The trigger value specified there is a 3-year running average of 8 in the Maryland Chesapeake Bay young-of-year striped bass survey. The Maryland index was incorporated into Amendment 3 because the Chesapeake Bay stock of striped bass traditionally accounted for 60 to 90% of total coastal landings of striped bass, and it was the Chesapeake stock which exhibited a precipitous decline in reproductive success beginning in the mid-1970s. Table 4.1 presents the Maryland index values, together with the running 3-year average values from 1956 to the present. The running 3-year average has not exceeded 8 since 1975.

The rationale for use of young-of-year indices as triggers in the management plan is that they represent an "early warning" signal of low stock abundance. Low reproductive success demonstrated by a low index value allows management actions to be taken which will conserve those yearclasses of fish which may not yet have been exploited because of protective minimum size limits, thus ensuring that a sufficient breeding stock is available in future years. It is generally accepted that one major reason for the striped bass decline in the 1970s was that low reproductive success occurred because insufficient actions were taken to restrict harvest, with the result that the stock of fish available for spawning was decreased to critically and unacceptably low levels.

The Maryland YOY index has been generally accepted as being the most reliable of juvenile indices for the various striped bass stocks along the East Coast. Reliability is based on the degree to which the annual juvenile index accurately represents the relative abundance of the yearclass of fish produced in a given year. To establish reliability, statistically significant relationships must be demonstrated between the relative magnitude of the index value from year to year, and either the relative magnitude of harvest from that yearclass when recruited to the fishery or the relative magnitude of abundance as measured by fishery-independent means (e.g., scientific sampling programs).

Analyses done to date by Maryland DNR and USFWS have demonstrated the reliability of the Maryland index to the satisfaction of the ASMFC S&S Committee.

Table 4.1 Young-of-year striped bass per seine haul by area and year (data from Md. DNR, corrected in April, 1988; tables appearing in previous documents may include several incorrect numbers)

Year	Nanticoke River	Choptank River	Head of Bay	Potomac River	Yearly Average	Running 3-Year Average
1954	25.1	1.2	0.9	5.2	5.2	-
1955	5.9	12.5	4.4	5.7	5.5	-
1956	8.2	9.8	33.9	6.2	15.2	8.6
1957	1.3	2.1	5.4	2.5	2.9	7.9
1958	22.5	19.5	28.2	8.4	19.3	12.5
1959	1.8	0.1	1.9	1.6	1.4	7.9
1960	4.7	9.0	9.3	4.3	7.1	9.3
1961	1.5	6.0	22.1	25.8	17.0	8.5
1962	6.6	6.1	11.4	19.7	12.2	12.1
1963	4.1	5.4	6.1	1.1	4.0	11.1
1964	13.3	10.6	31.0	29.1	23.5	13.2
1965	21.6	9.5	2.2	3.4	7.4	11.6
1966	3.3	13.6	32.3	10.5	16.7	15.9
1967	4.1	5.3	17.4	1.9	7.8	10.6
1968	9.0	6.3	13.1	0.7	7.2	15.6
1969	6.2	4.8	26.6	0.2	10.5	8.5
1970	17.1	57.2	33.1	20.1	30.4	16.0
1971	2.0	6.3	23.7	8.5	11.8	17.6
1972	25.0	11.0	12.1	1.9	11.0	17.7
1973	1.1	1.0	24.7	2.1	8.9	10.6
1974	3.9	15.3	19.9	1.5	10.1	10.0
1975	5.2	4.7	7.6	7.8	6.7	8.6
1976	1.7	2.4	9.8	3.2	4.9	7.2
1977	1.0	1.2	12.1	1.9	4.8	5.5
1978	4.8	6.0	12.5	7.9	8.5	6.0
1979	0.9	2.8	8.3	2.2	4.0	5.7
1980	1.8	1.0	2.3	2.2	2.0	4.8
1981	2.4	1.3	0.3	1.4	1.2	2.4
1982	6.2	13.0	5.5	10.0	8.4	3.9
1983	1.0	.9	1.2	2.0	1.4	3.7
1984	1.5	2.8	6.1	4.7	4.2	4.7
1985	2.1	3.7	0.3	5.6	2.9	2.8
1986	2.2	0.5	1.6	9.9	4.1	3.7
1987	2.5	12.1	0.3	6.4	4.8	3.9
1988	0.4	0.7	7.3	0.4	2.7	3.9
1989	2.9	97.8	19.4	2.2	25.2	10.9
Mean	6.3	10.1	12.6	6.3	8.9	
Standard Error	1.2	3.0	1.8	1.2	1.2	

Other juvenile indices which exist include Albermarle Sound-Roanoke River, Virginia tributaries (York, Rapahannock, and James Rivers), Delaware River, Hudson River, and Kennebec River. None of these indices have to date been subject to the same degree of evaluation and analysis as has been the Maryland Chesapeake Bay index. For that reason, none are considered validated at the present time, although preliminary analyses suggest that several may meet the validation requirements identified in the management action presented below. At the point at which they are validated, those indices will be formally incorporated into the management plan.

The manner in which other indices, when validated, will be incorporated into the management plan will take into account the following major points:

- Currently, most management of coastal striped bass is driven by the Maryland young-of-year index, and this situation will continue until other indices are validated

- Individual indices can be used to guide the management of individual stocks in waters where fisheries are impacting only those stocks

- It is desirable to combine the Virginia and Maryland indices into a single Chesapeake Bay index, if the combined index can be validated

- It is not necessary at the present time to incorporate the Kennebec and Delaware indices into management plan trigger mechanisms for areas in which stocks are mixed (e.g., coastal waters); in the future, if stocks of those systems reach substantial size, measures would have to be taken to incorporate the indices into coastal triggers

- The Albermarle Sound index should be used to guide management within the Albermarle/Roanoke system, and may have to be taken into account in coastal triggers when the stock has recovered, depending on findings regarding Roanoke contributions to coastal stocks.

- Areas should be defined for coastal waters, within which stock composition is believed to be relatively homogeneous, but among which stock composition differs substantially; appropriate juvenile indices should then be applied to management in those areas, dependent on the degree of dominance of particular stocks; however, management would not be based on a combined index value but would be based on the need for protection of any stock exhibiting poor reproductive success; for

example, in a northeast region, in which both the Hudson and Chesapeake stocks are present in abundance, a decline in either the Hudson or Chesapeake stock, individually, would trigger a more restrictive management regime; the primary objective of this management approach is to ensure protection of a major stock which is exhibiting poor reproduction.

- Data useful for rigorously defining boundaries of such potential management areas does not presently exist; those states which believe their waters should be included in one management area rather than another should bear the burden of collecting data to support that contention.

A numerical criterion for establishing that a particular stock is "dominant" in a proposed management area must be sufficiently restrictive to ensure that a depressed stock will not be excessively impacted by relatively intensive fisheries directed at a healthy stock. The extreme criterion from this perspective would be that 100% of the fish being harvested be from the healthy stock. However, a more realistic criterion would be sufficiently liberal to allow for fisheries on healthy stocks in areas where some fish from a depressed stock may be present. The criterion selected to meet these needs was 80%; that is, in zones were 80% or more of the fish being exploited are from a single stock, management within that zone will be guided by the juvenile index of that stock alone.

Several of the management actions presented below address trigger levels of juvenile indices, based on current knowledge and statistical characterizations of those indices. Future analyses and reassessment of the representativeness and accuracy of some of the indices might result in modification of the index itself or in the value of the index which triggers some change in management regime. As an example, a change in the averaging method (e.g., going from an arithmetic mean to a geometric mean) would result in a change in the long-term average. Application of some type of weighting scheme, intended to have the index reflect relative size of spawning areas, would result in individual annual index values changing as well as the long term average. Development of a combined Maryland/Virginia validated juvenile index for the Chesapeake Bay will also result in a change in the trigger value for the Chesapeake Bay stock.

Management Action 3. Young-of-year abundance indices for individual striped bass stocks will be considered valid if they meet two criteria:

- The sampling protocol (stations, sampling intensity and gear type) should be consistent across the years for which the index is to be used, and

- The indices should exhibit some significant ($p<0.05$) positive correlation to either the magnitude of future landings (lagged 2-7 years) from that stock, or to the relative abundance of the same yearclass later in life (i.e., relative abundance of juveniles versus the relative abundance of yearling fish of the same yearclass).

In order to be formally approved as valid, the index sponsor must provide for review by the Striped Bass Technical Committee a formal submittal presenting:

- Details of the sampling design of the study yielding the data used to develop the index

- A description of the analyses performed

- A presentation of the results of those analyses.

The committee shall review any such submittal and either accept or reject it. If rejected, the Committee will provide a written explanation to the sponsor explaining the reasons for rejection.

Management Action 4. Special management areas for striped bass will be permitted within certain geographical areas where a single stock comprises at least 80% of the total abundance of exploitable striped bass. A stock is considered "dominant" only if it remains above the 80% level within the proposed area during the entire fishing season. If this precondition and others (see Management Action 5) can be demonstrated through preliminary studies, management of striped bass within these management areas will be guided solely by the juvenile abundance index for the dominant stock. Fisheries within areas where a single stock does not dominate (i.e., where percentage composition falls below 80% during the fishing season) will be managed according to the juvenile indices of all stocks occurring in those areas. In this case, all stocks will be fished at reduced rates when the 3-year running average of at least one of the YOY indices drops below its long-term average. The Maryland YOY index will be used as the trigger for the Chesapeake stock until a validated Maryland/ Virginia index is developed.

Management Action 5. State(s) that are claiming a need for discrete management areas should conduct a feasibility study to provide clear and convincing evidence that the F experienced by striped bass will not exceed the target levels ($F=0.25$, 0.5). The state(s) claiming the management area should also present information on the type of fishery (recreational and/or commercial), the length limit, bag limit, commercial gear and the duration of the fishing season within the proposed management area. In addition, since the migration rate of Chesapeake Bay and Hudson River striped bass may vary greatly over time, stock

ID studies should be performed with a sample frequency sufficient to demonstrate that the percentage of the dominant stock within the proposed area remains above 80% for the entire fishing season. Estimates should be provided with at least an 85% level of confidence that the target stock composition value is exceeded. The experimental design for these pilot studies should be given to the Striped Bass Technical Committee for review at least six months prior to initiating these pilot studies.

Management Action 6. The trigger value of the Maryland YOY index, representing the Chesapeake Bay striped bass stock, will be 8.0. When the 3-year running average of that index equals or exceeds this value, this stock may be exploited at a rate of 0.25. Should the running 3-year average of the index drop below 8.0, the Striped Bass Technical Committee will evaluate how to reduce exploitation rates to an acceptable level, with the amount of reduction required being based on the degree of the decline below 8.0 and the status of other stock indices to be discussed below. Should the running 3-year average of the index increase above 8.0, exploitation rates may be increased, depending on the status of other stock indices discussed below. Development of a validated combined Maryland/Virginia juvenile index for the Chesapeake Bay may result in the trigger value being changed.

Management Action 7. The trigger values for validated juvenile indices for non-Chesapeake Bay stocks will be the long-term average of the validated index during a period when the stock was not depressed or declining. Stocks for which the running 3-year average equals or exceeds the long-term average may be exploited at a fishing rate of F=0.25, if other stock indices addressed below are at acceptable levels. Should the running 3-year average drop below the long-term average, the Striped Bass Technical Committee will evaluate how to reduce exploitation rates to an acceptable level, with the amount of reduction required being based on the degree of the decline below the average and the status of other stock indices to be discussed below. Should the index increase above the long-term average, exploitation rates may be increased, depending on the status of the other stock indices discussed below.

5. MANAGEMENT PLAN ADULT STOCK TRIGGERS

The use of the YOY index as a management trigger, as indicated above, is intended to prevent the collapse of striped bass stocks at some time in the future. The YOY index is not, however, an indicator of whether or not a stock is fully restored and at a self-sustaining level, which is the stated objective of this management plan. A determination of whether a stock is fully restored is necessary in order to move from the transition management regime (F=0.25) toward the long-term management regime(F=0.5) within this management plan.

Spawning populations of stocks which were being fished at acceptable levels (e.g., Chesapeake Bay stocks in the 1960s, current Hudson stocks) were consistently composed of significant numbers of fish older than the age of complete female sexual maturity. On the Hudson River, for example, from 1985 through 1988, the percent of spawning fish of both sexes age 8 or older ranged between 19% and 26%, with 8 being the age at which about 95% of the females of a yearclass reach sexual maturity. Some data suggest that the comparable age of female maturity of the Roanoke stock may be age 6 rather than age 8.

An age distribution of the spawning stock which includes a substantial portion of older fish is indicative of fishing rates sufficiently low so that significant numbers of females survive to spawn over many years. Large, old females produce large numbers of eggs, which may be more viable than eggs of younger, smaller fish, thus enhancing reproductive potential of the spawning stock. In addition, a substantial pool of older fish acts as a buffer against intermittent poor reproduction, serving as a reservoir of reproductive potential for the future.

Spawning populations in which X%* or more of the females are of or beyond the age of full maturity represent stocks at a healthy and sustainable population level. However, factors other than fishing may also influence the age structure of the spawning population. Thus, the designation of a numerical trigger value for spawning stock age composition, in the absence of consideration of extenuating factors, would not be appropriate. For example, in a rapidly growing population, or one in which several years of exceptional reproductive success

* This figure is under development by the S&S Committee using historical data, and will be finalized and adopted by 1 January 1991. It is expected that this trigger will not be reached for several years, and thus postponement of its development for several months does not affect plan implementation.

has occurred, a low percentage of older fish may occur in the spawning stock despite the fact that the stock is very healthy. Thus, spawning stock composition is viewed as a trigger for consideration of all available data to determine whether management should shift from the transition phase to the long-term regime.

Management Action 8. Spawning stock composition of each of the major stocks (Hudson, Chesapeake, Albermarle/Roanoke) shall serve as a major factor in determining whether to move to the long-term management regime. When X%* or more of the spawning females in a given season exceed the age of full sexual maturity, the Striped Bass Technical Committee will evaluate all available biological data and any and all related factors (e.g., existing fisheries, effort levels, environmental quality) and the ISFMP Policy Board will determine if a shift to the long-term management regime from the transition management regime is justified. Should this same percentage drop below 50% when long-term management regimes are in place, the Technical Committee shall evaluate, and the ISFMP Policy Board shall determine whether a shift back to a transition management regime is justified. At the time of implementation of this amendment to the plan, the Hudson stock has been determined to be exploitable under the long-term management fishing rate target.

Management Action 9. Decisions on shifts from transition to long-term management regimes in Special Management Areas based on spawning stock composition and other factors shall be applied in the same manner as are decisions based on juvenile index triggers (e.g.,within waters where single stocks are being fished and within management areas as defined in Management Action 4).

* This figure is under development by the S&S Committee using historical data, and will be finalized and adopted by 1 January 1991. It is expected that this trigger will not be reached for several years, and thus postponement of its development for several months does not affect plan implementation.

6. FISHERIES HARVEST REGULATIONS

The adaptive management approach specified in this management plan identifies fishing rates (F) which are believed to be necessary to sustain acceptable levels of population growth under certain defined circumstances. Target F values, identified and specified in Recommendation 2, were determined using all available biological data and state-of-the-art mathematical modeling. Target fishing rates have been determined to be those which, during transition, would allow for some harvest but also allow the population to grow until fully restored, and, for long-term, to allow greater harvest but at a level which provides some conservative buffer against overharvest and which ensures that the population will continue to sustain itself at its restored level.

The means of ensuring that the target fishing rates are met and maintained are the harvest regulations to be imposed by each state. In earlier assessments, it was determined that regulatory measures which should be used to implement this management plan might include: limitations on fisheries in spawning areas during the spawning season, size limits, recreational bag limits and closed commercial fishing seasons. Other measures, such as coastal quotas, were determined to be infeasible at the present time, given current state of knowledge about striped bass stocks and inadequate means of achieving real-time tracking of recreational and commercial harvests. However, the concept of limiting total commercial catch to some maximum figure as a means of ensuring that target fishing rates would not be exceeded was considered possible.

Individual states may implement other more restrictive measures than those proposed here, such as restrictions on gear type and/or allocation among user groups, based on their own specific needs. Such locally-specific restrictions are beyond the pervue of this management plan.

Spawning Ground Restrictions

An appendix of the Source Document describes the spawning areas identified for each spawning system. The nature of the spawning grounds in the different drainage systems differs significantly. The identified spawning area in the Hudson is tidal but extends over more than 100 river miles, while comparable spawning sites in Chesapeake Bay tributaries are much shorter reaches. In the Roanoke, spawning occurs in entirely riverine habitat, with eggs and larvae being transported over a

very long stretch of river. Fisheries which traditionally occurred in these different systems also differ considerably.

Directed fisheries for spawning fish on the spawning grounds pose a potential problem because of the vulnerability of fish to harvest at that time and the likelihood that increases in effort during that time could result in overharvest.

Management Action 10. Because of the vulnerability of spawning fish on the spawning grounds, and because of their great value to reproductive potential of the stock, spawning ground closures should be considered for implementation in cases where stocks are severely depressed or in initial stages of recovery.

Size Limits

The function of size limits in fisheries management is different in some respects from that of other conservation measures, such as bag limits and seasons. While bag limits and seasons are specifically intended to control the proportion of a stock which is harvested during a certain period of time, size limits essentially exclude a certain segment of the stock from any harvest. Minimum size limits are usually set so that fish are not vulnerable to exploitation until they are of a certain age. Combinations of size limits and bag limits/seasons are then selected so that the net effect is an acceptable population growth rate and protection against stock collapse.

The impact of size limits in combination with other management measures has been evaluated using striped bass population computer models. Management alternatives for implementing both the transition and long-term management regimes and which employ different size limits were considered during plan development. Several of these alternatives included the application of dual size limits: a smaller size limit in "inshore" or "producing" waters, and a larger size limit in "coastal" waters.

The primary justification for use of a dual size limit approach in striped bass management is as follows:

- Smaller size limits in "producing areas" are necessary for the maintenance of historical fisheries on native fish which have primarily small fish available to them; in the Chesapeake Bay, most striped bass remain in the Bay for only 2 to 6 years before leaving to take part in coastal migrations; large mature fish return each year for only a brief period to spawn in the Bay, returning to coastal waters after spawning.

This justification has been adopted as a basis for smaller size limits being applicable within the Chesapeake Bay, Albermarle Sound, and the Hudson River estuary.

Criteria which are acceptable to characterize areas where smaller size limits can be applied, pursuant to the above justification are as follows.

- Primarily small native fish are available in the defined area
- Traditional fisheries in the area have historically targeted small fish
- The defined area is one in which fish reside more or less continuously until they join the coastal stock at ages between 2 and 6.

One major difficulty encountered in attempting to apply these criteria in the New York-New Jersey area is that Chesapeake fish move through the lower Hudson estuary area on a regular basis. Currently available stock discrimination data are limited in geographical and temporal coverage and show that the percentages of the different stocks present in a particular location vary widely over time.

Pursuant to the preceeding criteria, expansion of the "producing" waters boundary for the Hudson stock to a new location downstream from the George Washington Bridge, the southern limit of the Hudson River spawning and nursery area as defined in the existing management plan, is warranted at this time. The danger of overexploitation of the Chesapeake stock due to this boundary change is minimal and poses no substantial threat to Chesapeake stock recovery. This action allows expansion of the area within which Hudson fish may be exploited at a rate commensurate with their healthy stock status. This action does not, however, in any way deal with restrictions on harvest due to PCB contamination, which supercede any restrictions specified in this plan.

Management Action 12, presented below, allows states to propose alternative management regimes, if they can demonstrate that those alternatives will allow management targets and objectives to be met. Demonstration of the adequacy of alternatives is likely to be more feasible after a period during which the overall management regimes proposed here are implemented and monitored. After such a period, monitoring of stocks and fisheries may permit reliable estimates of fishing rates to be established.

In recognition of the present status of the Albemarle Sound-Roanoke River striped bass, an amendment was included in the

1988 renewal of the Atlantic Striped Bass Conservation Act directing that a study be undertaken to obtain additional biological information to understand the significance of fishing, water flows, and other factors impacting this decline. The responsible agencies, through the North Carolina Striped Bass Study Management Board, are to develop an effective course of action for restoring these important stocks of striped bass and include in their report recommendations to the affected states and the Congress within three years.

The Study will include, to the extent possible, the following topics, as specified in the Act:

1) A description of the Albemarle Sound-Roanoke River basin area.

2) An investigation and analysis of the effects of land and water use practices on the striped bass population and habitats of the area.

3) An investigation and analysis of the abundance and age and geographic distribution of the Albemarle Sound-Roanoke River stock of striped bass, including the amount and geographical location of migration and spawning habitat.

4) An investigation and analysis of factors that may affect the abundance and age and geographic distribution of the Albemarle Sound-Roanoke River stock of striped bass, including the extent and causes of mortality at successive stages in the life cycle of striped bass, including mortality due to recreational and commercial fishing.

5) An investigation of the combined effects of pollution and other natural and human alterations of the physical environment, including the effects of water withdrawals, discharges, and flows, on striped bass migration and spawning and on the viability and condition of eggs and larval fish.

6) An investigation and analysis of the status and effectiveness of current striped bass management measures implemented by State and Federal authorities, including State fishing regulations and Federal fish stocking activities, reservoir management and water flow regulation, and an analysis of whether any additional State or Federal measures would be effective in halting the decline and initiating the recovery of the Albemarle Sound-Roanoke River stock of striped bass.

7) A recommendation of whether conservation of the Albemarle Sound-Roanoke River stock of striped bass could be improved by management of this stock under the provisions of the Atlantic States Marine Fisheries Commission's Interstate Fisheries Management Plan for Striped Bass and the Atlantic Striped Bass Conservation Act.

Management Action 11. The smaller of two size limits identified by this management plan as being required to meet management targets shall be incorporated into state regulatory regimes to apply to the following water bodies: Albermarle Sound (inshore waters of North Carolina); Chesapeake Bay (up-Bay from a line extending from Cape Henry to Cape Charles); and, the Hudson River and estuary (to the west of the Throgs Neck Bridge, and to the north and west of a line extending from the tip of Sandy Hook in New Jersey to Rockaway Point, on the western end of Long Island, and upstream to include the Hudson River); the larger of the two size limits shall apply in all other waters (here termed coastal waters); should reproducing stocks of striped bass in other major estuarine systems (e.g., Delaware River and estuary) attain levels which can sustain directed exploitation, producing areas may be defined for those systems by the Striped Bass Technical Committee and included in this plan.

Management Action 12. States may submit to ASMFC for consideration alternative regulatory regimes which deviate from the regulatory elements presented in Management Actions 10, 11, 16, and 17 but which they believe will achieve the management targets specified in this plan; such submittals must be accompanied by technical and scientific justifications and explanations and will be reviewed for adequacy by the Striped Bass Technical Committee and submitted to the ISFMP Policy Board for approval. Individual state quotas on commercial landings may be submitted pursuant to this action. For the purposes of conforming to the transition management regime set forth in Management Action 16 of this amendment, such commercial quota should not exceed 20 percent of a state's commercial landing averaged over the base line years 1972 through 1979.

7. MONITORING PROGRAM

Because of the adaptive management approach to be used in this program, monitoring of fishing rates, reproductive success and stock status is essential for success of the program, since continual modifications to management regimes are anticipated based on observed levels of fishing and stock fluctuations. The essential elements of the long-term monitoring program necessary for implementation of this management program include:

- Juveniles: Annual assessment of juvenile abundance in each of the major spawning grounds (Hudson River, major Maryland and Virginia tributaries of the Chesapeake Bay, Roanoke River/Albermarle Sound, Kennebec and Delaware Rivers); juvenile abundance indices represent one of the key triggers in the overall management scheme

- Adults: Annual spawning stock assessment in major spawning areas (Hudson River, representative major tributaries within the Chesapeake Bay, Roanoke river); fishery-independent surveys of the spawning stock must provide consistent unbiased estimates of relative abundance by age, sex and size samples of fish; spawning stock characteristics will be used as another trigger in the management approach to assess whether stocks are fully restored and will be one source of estimates of fishing mortality (F); annual fishery-independent surveys of the coastal migratory stock (fall Long Island haul seine surveys and possibly winter North Carolina coastal trawl surveys); these surveys will provide a second means of estimating F, of estimating yearclass abundance for further validation of juvenile indices.

- Harvest: Continued and improved monitoring of both commercial and recreational harvest of striped bass and the age, size and sex composition of that harvest; such information is essential for assessing harvest distribution among user groups and regions, for identifying the potentially most effective revisions to existing management regimes, and for substantiating estimates of F derived from fishery independent sampling.

  It is extremely important that the accuracy of harvest estimates from each of the states be sufficent to meet management needs; this is the only means to ensure that inequitable harvest distribution does not occur due to incomplete or inaccurate harvest records.

- Tagging: Long-term continuation of coordinated, multi-state tagging program; this program provides information needed for estimating fishing rates, partitioning F among user groups, providing stock-specific information on biological and fishery characteristics, allowing continued validation of parameters of models being used to guide management, and allowing evaluation of existing hatchery programs.

  The effectiveness of tagging programs is heavily dependent on the consistent and complete reporting of fish recaptures. Some fishermen, both sport and commercial, believe that by retaining tags and not reporting harvest they will ensure that liberal fishing restrictions will not be made more restrictive. In reality, complete reporting of all recaptures improves understanding of the biology and behavior of striped bass and makes it more likely that management measures will be successful, so that future striped bass harvests will be enhanced. It is imperative that the states make every effort to encourage user participation in and cooperation with the coordinated tagging program.

- Stock Discrimination: Assessment of stock composition of fish being harvested in coastal regions; this information is important in providing guidance on whether and how to impose harvest restrictions to protect individual target stocks; regular collection of this information once fisheries are reestablished will help document typical patterns of stock distribution and mixing.

The monitoring program elements just described are essential for proper management of coastal striped bass stocks and provide the only means of ensuring that stock collapse, such as has occurred in the past, will not occur in the future. Based on current costs of ongoing programs of a similar nature, total cost for these elements of the monitoring program is anticipated to be on the order of $2.5 million, in 1988 dollars. Current programs are being funded from several sources, including state agency funds, Wallop-Breaux, Emergency Striped Bass Program, and Anadromous Fish Act funds.

Programs identified in Tables 7.1-7.3 are subject to review and modifications by the Sriped Bass Technical Committee and Policy Board. Flexibility and responsiveness to new findings and sampling technologies are intended to be implicit in these programs.

Table 7.1. Current striped bass monitoring programs, agencies responsible for their implementation

Program Element	Agencies
YOY Surveys	MDNR, VMRC, NCMF, DRBC, NYDEC, MDMR
Spawning stock assessment	NCMF, VIMS, MDNR, NYDEC
Harvest (commercial and recreational monitoring)	All states, NMFS
Tagging	USFWS, RI, NY, MD, VA, NC
Stock discrimination	NMFS, all states

Table 7.2 Specifications for fishery independent sampling needed to monitor striped bass stock status

Study	General Guidelines	Responsible Agencies
Juvenile indices	Active gear (seines, trawls); 100-200 ft seines; frequency, duration and station location sufficient to produce reliable and representative measures of c/f	MDNR, VIMS, NCMF, NJMFA, NYDEC, MDMR
Spawning Stock Assessment	Fish to be sampled annually during spawning season; non-selective gear, so that all ages are equally vulnerable; record age distribution, sex ratio, size frequency; sample size, frequency, duration and locations sufficient to ensure representative results.	VIMS, MDNR, NYDEC, NCMF; DDFW may be added at a later date
Stock Characterization	Two programs should be continued: NC ocean trawl, Long Island haul seine; a September-November program should be initiated in Massachusetts; programs should use non-selective gear; sampling for age distribution, CPUE, size distribution, and sex ratio; also conduct stock ID work and tagging.	USFWS, NMFS, NYDEC NCMF, MDMF
Stock Identification	Representative sample with fully justified sample size per time and geographical stratum.	Agencies requesting special management areas
Tagging	All spawning stocks (but terminate when water temperatures reach about 65 F); RI, LI ocean seine haul, NC winter trawl	USFWS, RIMF, NYDEC MDNR, VIMS, NCMF, NJMFA

Table 7.3 Fishery dependent monitoring

Study	General Guidelines	Responsible Agencies
Commercial		
Catch Composition	Samples demonstrated to be representative of locations and seasonal distribution of catch; age frequency, size distribution, sex composition.	All states with commercial fisheries
Catch and Effort	Log book reporting or mandatory reporting or port agent interviews which are demonstrated to produce reliable measures of catch in numbers and weight and of effort in gear days fished; reported sales (purchases) by buyers/ dealers (optional)	All states with commercial fisheries
Recreational		
Catch Composition	Roving creel survey; samples demonstrated to be representative of locations, seasonal distribution and mode of catch; age distribution, size frequency.	Key states (MA, RI, CT, NY, NJ, MD, VA)
Catch and Effort	MRFS, with expansions to achieve 20% coefficient of variation in key states; non-key states will be covered by regular MRFS. Individual states may propose specialized striped bass rec. surveys which they feel better assess their harvest	All states, as specified in guidelines

Management Action 13. State and federal agencies currently conducting essential striped bass monitoring programs must continue such programs as long-term elements of this management plan. Federal funding currently supporting many of these state programs must be continued at current funding levels at a minimum. Table 7.1 presents current programs and the states and/or agencies conducting those studies.

Management Action 14. State and federal agencies must conduct fishery-independent studies as specified in Table 7.2. Agencies will submit monitoring plans for review by the Technical Committee and approval by the ISFMP Policy Board.

Management Action 15. All jurisdictions that intend to exploit this resource are required to implement, prior to the allowance of fishing, data collection systems that provide commercial and recreational striped bass harvest estimates of sufficient accuracy and timeliness to meet management needs. Detailed requirements of these fishery-dependent data collection systems are presented in Table 7.3. Proposed data collection systems must be submitted for review by the Technical Committee and approval by the ISFMP Policy Board. The target date for submittal of harvest data for Technical Committee review and evaluation will be April after the calendar year of the harvest.

8. PREFERRED MANAGEMENT ALTERNATIVES

As was discussed earlier, mathematical models were used to evaluate the consequences to striped bass stocks of various regulatory regimes. The key parameters relative to management within these models were fishing rate (F), size limits (in producing and coastal waters), population growth rate (reflecting the potential resiliency of the population under the given management regime), the fishing rate at which stock collapse would occur (a critical threshold value), and allocation of harvest between Chesapeake Bay and coastal areas.

The models were primarily used to assess the consequence to the stock of different fishing rates, which was the basis for arriving at a transition fishing rate of F=0.25 and a long-term fishing rate of F=0.5. The models were not appropriate for determining the fishing seasons and bag limits necessary to meet the target fishing rate. Additional analyses of historical data were used for this purpose.

Historical data indicate that fishing rates during the 1970s were on the order of F=0.8 or higher. Using equations relating fishing rate to per cent of stock removed, it was determined that a reduction of 60% or more in harvest during the 1970s would have been required to reduce F from 0.8 to 0.25.

Commercial fisheries during that time period operated under very few limitations and virtually no seasonal restrictions. Thus, the seasonal pattern of harvest during the year in essence reflected the seasonal pattern of availability of fish during the year. Assuming that the seasonal pattern of availability of fish in the future will be the same as it has been in the past, commercial fishing season closures were identified which, in the 1970s, would have eliminated 60% and 29%, respectively, of the harvest. These season closures were the "first cut" at defining seasons which will result in the target fishing rates of F=0.25 and F=0.5, respectively. Later consideration of the likelihood that fishing effort in the future may be higher than anticipated lead to a decision to establish seasons during the transition period which are consistent with an 80% reduction in historical harvest.

Specifically, commercial harvest in each month of the year was averaged over the period 1972 to 1979. The percentage of the average annual harvest taken in each month was then calculated. Closed seasons were then identified which would have resulted in the elimination of 80% of the average harvest each year. For example, if in any given state 20% of the average annual harvest over the period 1972-1979 was taken in March as well as in April,

May and June, a fishing closure during those four months would eliminate 80% of the average annual harvest and meet the requirements of the procedure being applied here.

Not withstanding some scientific uncertainty associated with this approach to achieving target fishing rates, the approach represents the best use of existing information for achieving management objectives. Such uncertainties also reemphasize the need for consistent and accurate monitoring of stock management parameters, such as fishing rate and harvest. It must also be noted that commercial fisheries are defined here as any harvest which includes sale of fish, regardless of gear used.

Very little detailed data is available on striped bass recreational harvest. The majority of such infomation has been acquired in National Marine Fisheries Service marine recreational fishing surveys conducted over the past decade. The limited amount of striped bass information acquired in these surveys allowed an analysis of the distribution of striped bass harvest among fishermen. Such distributions reveal the percentage of fishermen that caught certain numbers of striped bass(e.g., 0, 1, 2, etc.) per day. Using this information, it is possible to estimate the percentage of total recreational striped bass harvest which would be eliminated if a possession bag limit was set at any particular number (e.g., 1, 2, 3, etc.) per day. Bag limits were then identified which would have reduced recreational harvest by approximately the amount needed to meet transition and long-term fishing rates. This approach assumes that overall level of recreational fishing effort when striped bass fisheries are liberalized will be the same as it was during the past decade; however, effort may increase substantially. For this reason, the bag limits chosen were somewhat conservative. For the transition fishery, a bag limit was identified which corresponded to an 80% reduction in striped bass harvest. The uncertainty associated with this approach, as is the case with commercial fishing season closures, also emphasizes the need for consistent and accurate monitoring of fishing rates and harvest.

Six size limit combinations for producer and coastal areas were considered to be desirable for socio-economic reasons and/or biological reasons. These size limit combinations were then inserted into the mathematical models to assess the manner in which striped bass stocks may respond, given those size limits and given seasons and bag limits which are intended to meet the target fishing rates.

It should be noted that there are many uncertainties in model results, primarily due to uncertainties and wide variation in important data inputs to the models. For this reason, model results must be viewed cautiously, and striped bass fisheries must be reestablished in a very conservative manner. Any error

made which results in harvest greater than can be supported by the stock would result in a repeat of a stock collapse and a long stock recovery period similar to what has just been experienced by user groups.

Table 8.1 presents model predictions for various model outputs under both transition and long-term management regimes and for the six different size limits combinations considered. CRC and FWS indicate two different modeling approaches used for these assessments, and the difference in outputs should be considered as a range within which the actual result is likely to fall.

Several key points are evident upon review of Table 8.1. At the long-term fishing rate of F=0.5, smaller size limits result in very low population growth rates, which indicates that there is little buffer in the stock. That is, if fishing rates should exceed the target rate by relatively small amounts, stock collapse could occur. This is evidenced in the values for F at stock collapse presented in the two right-most columns in the table; many of those values are very close to the target fishing rate.

During the transition period, with F=0.25, population growth rates are very similar for all size limit combinations, but there is a substantial difference in the F at stock collapse values. Smaller size limit combinations make the stock much more vulnerable to overfishing and increase the probability of stock collapse.

Because of the nature of recreational and commercial striped bass fisheries which occur along the coast, most states are unable to accurately predict what the magnitude and extent of fishing directed at striped bass will be when the fishery is opened or liberalized. While a very low fishing rate of F=0.25 has been identified as the target transition rate, there is considerable concern that the actual rate will be substantially higher than the target. Data collection and analysis take a considerable amount of time, and a full year of data, collected over all seasons, is necessary to evaluate the nature and magnitude of any fishery. If new fishery regulations are established in January of any year, all necessary data will not be collected until the following January, and analysis of that data will probably not be completed until late summer of that year. Thus, serious overfishing could occur for nearly 2 years before it would be recognized and regulations changed to prevent it. Management Actions 15 and 18 identify target dates by which harvest data and mortality estimates are to be available, in order to minimize potential consequences of such delays.

It is because of this uncertainty about expected fishing effort and the time lag in assessing whether overfishing may be

Table 8.1. Model predictions of allocation of striped bass yield and F at stock collapse assuming a closed spawning season in Chesapeake Bay (% allocation with an open spawning season in the Bay is given in parentheses), natural mortality of M = 0.2, and non-catch mortality of sublegals equal to 20% of F for transition (F = 0.25) and long-term (F = 0.5) management regimes.

Minimum Length		% Yield in Chesapeake Bay with F = 0.25		% Yield in Coastal Waters with F = 0.25		Annual rate of pop growth with F = 0.25	F at stock collapse	
Bay	Coast	CRC	FWS	CRC	FWS	FWS	CRC	FWS
18	18	20(40)	24(34)	80(60)	76(66)	20	0.65	0.56
20	20	18(38)	18(24)	82(62)	82(76)	22	0.73	0.63
16	24	20(40)	37(47)	80(60)	63(53)	21	0.70	0.60
16	28	20(40)	43(54)	80(60)	57(46)	24	0.85	0.71
18	28	19(39)	33(47)	81(61)	67(53)	26	0.95	0.81
24	36	34	52	66	48	31	2.02	1.38

Minimum Length		% Yield in Chesapeake Bay with F = 0.5		% Yield in Coastal Waters with F = 0.5		Annual rate of pop growth with F = 0.5	F at stock collapse	
Bay	Coast	CRC	FWS	CRC	FWS	FWS	CRC	FWS
18	18	51	38	49	62	3	0.65	0.56
20	20	47	32	53	68	7	0.73	0.63
16	24	51	52	49	48	6	0.70	0.60
16	28	49	59	51	41	10	0.85	0.71
18	28	48	52	52	48	13	0.95	0.81
24	36	40	58	60	42	23	2.02	1.38

occurring that one of the larger size limit combinations (18 inches in producing waters, 28 inches in coastal waters) is established as the management regime during the transition management period. Table 8.2 presents the seasons, recreational bag limits, and size limits which comprise that transition management regime.

While historical data from the 1960s and 1970s could be used to develop potential fishery management regimes for the long-term management regime, it is very likely that fisheries occurring in the future will be very different from the fisheries which existed in the 1960s and 1970s. By the time the spawning stock composition trigger is reached which would initiate an assessment of whether to move to the long-term management regime, several years of then current data on fishing rates and fisheries characteristics will be available. Thus, delineation of specific bag limits, seasons and other management measures which would be put in place for long-term management is premature at this time. It is possible that they will be more liberal than the measures specified for the preferred transition management alternative. However, it is also possible that fishing rates during the transition regime will be substantially higher than the target rate of 0.25. This situation could arise if fishing effort turns out to be much greater than anticipated. If this circumstance arises, the transition management regimes would have to be made more restrictive, and it is likely that the long-term management regimes would not be more liberal than those currently being proposed as the transition regimes.

Procedures for implementing this management regime are addressed in Section 13 of this document.

Management Action 16. Table 8.2 presents management regimes on a state-by-state basis which constitute the adopted transition management regime. The regulations identified in that table should be implemented by each state upon attainment of the Maryland YOY index trigger specified in Amendment 3 of the ASMFC Interstate Striped Bass Management Plan.

Management Action 17. Upon the decision to initiate movement to the long-term management regime, the Technical Committee and ISFMP Policy Board will review current data and information on fishing rates and fishery characteristics and identify management regimes for each state which will ensure that target fishing rates are met; movement to the higher fishing rate will be done on a step-wise basis, to ensure that overexploitation will be prevented.

Table 8.2 **Preferred transition alternative regulatory regimes which are intended to attain a fishing rate (F) of 0.25. Alternative regulatory regimes pursuant to Management Action 12, and subject to approval of the S&S Committee and ISFMP Policy Board, may be substituted for these regimes.**

State	Proposed Commercial Open Season	Recreational Bag Limit	Minimum Size Limits	Other
ME	Season selected to reduce harvest rate to 80% of historical rate	1	28	Hook & line only
NH	No commercial at present	1	28	
MA	Season selected to reduce harvest rate to 80% of historical rate	1	28	Hook & line only
RI	Season selected to reduce harvest rate to 80% of historical rate	1	28	Area restrictions on gill and trap nets. If PCB closure remains in effect, then no commercial fishery
CT	(No Commercial)	1	28	
NY (coast)	Season selected to reduce harvest rate to 80% of historical rate	1	28	If PCB closure remains in effect, then no commercial fishery
NY (Hudson)	16 Mar-30 Nov[b]	3[b]	18	If PCB closure remains in effect, then no commercial fishery
NJ	No commercial at present	1	28	Hook and line and spear fishing only. If PCB closure remains in effect, then no commercial fishery
DE	Season selected to reduce harvest rate to 80% of historical rate	1	28	Gill net mesh restrictions in March and April
PA	(No Commercial)	1	28	
MD (Chesapeake Bay)	Season selected to reduce harvest rate to 80% of historical rate	1[a]	18[a]	Quota-based system
MD (coast)	Season selected to reduce harvest rate to 80% of historical rate	1	28	
PRFC	Season selected to reduce harvest rate to 80% of historical rate	1	18	Limited entry, fixed gear only
DC	(No Commercial)	1	18	
VA (Chesapeake Bay)	Season selected to reduce harvest rate to 80% of historical rate	1	18	Only 2 fish >40'
VA (coast)	Season selected to reduce harvest rate to 80% of historical rate	1	28	
NC (coast)	Season selected to reduce harvest rate to 80% of historical rate	1	28	
NC (inland)	To be determined upon completion of studies and management plan in 1992			

[a] Only one of several acceptable alternatives.
[b] Season and bag limit correspond to F=0.5 since Hudson stock being exploited in this area is at restored status.

9. STOCKING

Because of the socioeconomic importance and desirability of striped bass, one response on the part of state and federal agencies to the decline of striped bass stocks has been to consider or initiate stocking programs. The objective of these programs has generally been to bolster existing depressed stocks until they have had an opportunity to recover to former levels. Stocking programs are currently underway in North Carolina, Chesapeake Bay, and the Hudson and Kennebec Rivers. Several other stocking programs, conducted by utilities which have facilities located on the Hudson River and Chesapeake Bay, are not formally being conducted as stock restoration programs. However, the activities have generally been coordinated with state and federal programs.

Many potential problems may arise with regard to the stocking of fish into open systems which already support native stocks and which also support numerous other species. Because of concern about such problems, the following recommendations are adopted.

Recommendation 1. Genetic integrity of Atlantic coast striped bass stocks from Maine to North Carolina should be maintained within river basins. Only progeny from native brood stock, when available should be stocked in river basins and coastal waters; progeny from brood stock from adjacent rivers or hydrologically similar systems should be used if native brood stock do not exist or are present in insufficient numbers to support a restoration program.

Recommendation 2. States conducting, initiating or permitting striped bass stocking programs in coastal waters from Maine through North Carolina should follow hatchery and stocking program guidelines presented in Table 9.1; program descriptions and plans should be provided to ASMFC for review to ensure that guidelines are being followed.

Recommendation 3. States conducting, initiating or allowing the stocking of striped bass or striped bass hybrids in coastal waters from North Carolina to Maine should provide adequate protection to wild stocks by rules, regulations or laws which will maintain genetic integrity of wild stocks, ensure protection from introduced diseases, and guard against the introduction of competing species; escapement of aquaculture species into the wild must be prevented.

Table 9.1. Guidelines for acceptable striped bass hatchery and stocking programs.

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1. Disease Certification Programs

   1.1 Hatchery-reared striped bass which are to be released into any open system should be screened for IPN virus to prevent spread and dispersion of that virus

   1.2 Additional research should be conducted to determine the pathogenicity of the IPN virus isolated from striped bass to other warmwater and marine species, such as flounder, menhaden, shad, largemouth bass and catfish

   1.3 Researchers and managers should fully review the known facts about the pathogenicity and life history of suspected disease organisms in known hosts before attributing loss of fish to the presence of that organism in new hosts

2. Tagging Programs

   2.1 A sufficient number of fish to be stocked in coastal waters should be marked to allow for determination of survival and percentage contribution to natural stocks

   2.2 Binary coded wire tags are the preferred means of marking hatchery-reared fish to be released into coastal waters

   2.3 All fish should be marked if one-million or less are stocked; for greater numbers, the percentage to be marked should be calculated based on the number of fish released and the estimated number in the natural stock

   2.4 Tag codes should contain information sufficient to identify each lot of fish stocked

3. Evaluation of Stocking Programs

   3.1 Continue the stocking and evaluation program long enough to allow for maturation and return of adult females

Table 9.1. Continued

3.2 Continue to conduct research to determine the limiting factors affecting recruitment; this research should not be contingent upon the success or failure of the hatchery program

3.3 Terminate stocking if restoration is successful as judged by return of young-of-year indices for a period of three years to levels determined to be acceptable, and by a decline in the ratio of marked hatchery fish to unmarked native fish*

3.4 Terminate stocking if marked and stocked fish fail to return as brood fish*

3.5 Terminate restoration program if fish return as brood fish but progeny fail to survive due to poor anthropogenic-related environmental conditions on the nursery grounds*

3.6 The evaluation program should be established as part of any stocking program and should be budgeted at a value equal to that of the stocking program

3.7 Monitoring of coded-wire tagged striped bass should be incorporated into all major existing fishery-dependent and fishery-independent monitoring programs. Attempts should be made to recover, decode and report CWTs to a centralized repository administered by the U.S. Fish and Wildlife Service. Percent composition of coded-wire tagged fish within samples should also be recorded. Special studies should also be conducted to assess survival, growth and distribution of hatchery-reared striped bass

4. Genetic Integrity

4.1 Genetic integrity of Atlantic coast striped bass should be maintained within river basins

4.2 Only progeny from native brood stock, when available, should be stocked in river basins and coastal waters

*Decisions on time for termination of a non-restoration program should be made by the state agency having jurisdiction over the program.

Table 9.1. Continued

4.3 Progeny from brood stock from adjacent rivers or hydrologically similar systems should be used if native brood stock do not exist

4.4 Stocking of hybrids should be restricted to inland freshwater reservoirs or to other systems in which escapement and reproduction can, and will, be controlled

4.5 Neither striped bass nor hybrids should be stocked in coastal or inland waters without notification and approval of the proper and official state fishery agencies

5. Stocking

5.1 Stocking of hatchery-reared fish should be recognized as only one tool available to resource managers and that the appropriateness of this tool will vary with circumstances

5.2 Either Phase I or Phase II fish are acceptable for stocking provided all fish are tagged

6. Coordination of State Programs

6.1 Programs should be coordinated among and within states by adherance to these guidelines

6.2 Each state should take appropriate regulatory or statutory action to insure that striped bass stocked by private entities into coastal waters be in accordance with these guidelines

6.3 To avoid duplication, tagging programs involving potentially migratory stocks of striped bass should be coordinated on a coast-wide basis

6.4 A central data base should be established for all tags used in coastal stocking programs

6.5 Coded wire tags should be placed only in the left operculum

10. HABITAT AND WATER QUALITY REQUIREMENTS

The contribution of degradation in water quality, particularly in the spawning and nursery areas, to the decline of east coast striped bass stocks has been the object of intensive study for over a decade (ESBS, 1986, 1987, 1988). To date, numerous factors, including toxic contaminants, low pH, and elevated metals levels, have been identified as possible contributory factors to the poor reproduction of Chesapeake Bay stocks of striped bass.

On the Hudson, reproductive success of striped bass has been excellent in recent years, but PCB contamination of the environment has led to the fish being inedible and thus to restrictions on harvest.

Other environmental alterations may also impact on the status of striped bass stocks. Construction, dredging, water-withdrawal and other types of projects in the vicinity of or on striped bass spawning, nursery and foraging areas may reduce habitat or alter its suitability for successful completion of striped bass life cycles. Facilities such as power plants may cause direct mortality of striped bass through such mechanisms as entrainment in cooling water flow and impingement on intake screens.

It is extremely important to realize that fisheries management measures cannot be effective in enhancing and protecting striped bass stocks if habitat and water quality are inadequate. While fisheries harvests are a major factor impacting on population status and dynamics and are amenable to control and manipulation, good habitat quantity and quality are the underpinnings of the very existence of a population. Without adequate habitat and water quality, there would be no fish for harvest.

Detailed presentations of data and evidence documenting the types of environmental impacts discussed above are presented in the revised source document for this management plan (ASMFC 1989). It is this material which serves as the basis for the recommendations presented below.

Recommendation 4. States in which striped bass spawning occurs should make every effort to declare striped bass spawning and nursery areas to be in need of special protection; such declaration should be accompanied by requirements of nondegradation of habitat quality, including minimization of nonpoint source run-off, prevention of significant increases in contaminant loadings, and prevention of the introduction of any new categories of contaminants into the area (via specific restrictions on NPDES

discharge permits for facilities in those areas); this action should be taken within the normal cyclical process of criteria review that occurs in most states; for those agencies without water quality regulatory authority, protocols and schedules for providing input on water quality regulations to the responsible agency should be identified or created, to ensure that water quality needs of striped bass stocks are met.

Recommendation 5. Water quality criteria for striped bass spawning and nursery areas should be established or existing criteria should be upgraded to levels which are sufficient to ensure successful reproduction; suggested criteria for key environmental variables and contaminants are presented in the Source Document for this management plan; protocols established in response to Recommendation 19 for interacting with water quality regulatory agencies within the state should be followed with regard to establishing acceptable water quality criteria, and any actions taken should be consistent with federal Clean Water Act guidelines and specifications.

Recommendation 6. State and federal agencies should take steps to limit the introduction of or eliminate contamination of the environment from compounds which are known to be accumulated in striped bass tissues and which pose a threat to human health; some compounds of concern identified by FDA are listed in Table 10.1, together with FDA action levels.

Recommendation 7. All state and federal agencies responsible for reviewing impact statements and permit applications for projects or facilities proposed for striped bass spawning and nursery areas shall ensure that those projects will have no or only minimal impact on local stocks; of special concern are natal rivers of stocks considered depressed or undergoing restoration; any project resulting in elimination of critical habitat (e.g., dredging, filling) should be avoided.

Recommendation 8. Projects involving water withdrawal (e.g., power plants, irrigation, water supply projects) should be scrutinized to ensure that adverse impacts resulting from impingement, entrainment, and/or modifications of flow and salinity regimes due to water removal will not adversely impact on striped bass stocks; water use and flow regime guidelines should be developed, where necessary, which are protective of striped bass spawning and nursery areas and which will ensure the long-term health of the stock.

Table 10.1. FDA listing of poisonous or deleterious substances in seafood

Chemical Substance*	Seafood Group	Action Level (parts per million)
Aldrin and dieldrin	Fish	.3
Chlordane	Fish	.3
DDT, DDE, and TDE[b]	Fish	5.0
Endrin	Fish and shellfish	.3
Heptachlor and heptachlor epoxide	Fish and shellfish	.3
Kepone (chlordecone)	Fish and shellfish	.3
Mercury (methyl mercury)	Fish, shellfish and crustaceans, and other aquatic animals	1.0
Mirex	Fish and shellfish	.1
PCBs[c]	Fish	2.0
Toxaphene	Fish	5.0

[a]Paralytic shellfish toxin was intentionally excluded from this appendix because it is a biologically produced chemical toxin.

[b]When the amounts of DDT, DDE, and TDE are added, any of the three found below 2 parts per million for fish is not counted for compliance purpose.

[c]PCBs found at 2 parts per milion in fish are the only poisonous or deleterious substance for which FDA has established a tolerance level that is promulgated through FDA's official rulemaking process.

Source: FDA Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Food.

11. RESEARCH NEEDS

Many data and information needs were identified during initiation of the current ASMFC management planning effort in the early 1980s and at the initiation of the Emergency Striped Bass Research Study. ESBS (USDOI and USDOC 1982) identified nine factors that could explain production declines of striped bass in the Chesapeake and Roanoke River stocks during the late 1970s and early 1980s: 1) toxic contaminants; 2) starvation of larval fish; 3) overexploitation; 4) predation on fry; 5) occurrence of unfavorable natural climatic events; 6) recent modifications of water use practices; 7) competition with other species for food and space; 8) reduction of water quality due to agricultural activities; and, 9) sewage treatment practices. Table 11.1 presents summaries of research findings of studies funded by ESBS over the past 8 years. Research in some of these areas is continuing. The State of Maryland has conducted extensive studies for many years which have generated much of the data used in population modeling and analysis. Many other states, including New York, Rhode Island, and Virginia, have also contributed to existing knowledge of striped bass biology.

The ASMFC Striped Bass Scientific and Statistical Committee, having reviewed ESBS findings and findings of many other studies being conducted by state and federal agencies and other organizations, identified information needs which have not been met to date. Information on each of these topics is deemed necessary for effective future management of east coast striped bass stocks.

1. Age-Specific Mortality Rates

Modeling work done to develop this proposed management plan treats mortality as it applies only to two categories of fish: recruited and non-recruited; age classes falling into each of those categories are dictated by the size limits established for coastal and in-shore waters, and age-specific migration rates; it is possible that both natural and fishing mortality may vary with age (i.e., size) of the fish; documentation of age-specific mortality may permit development of more precise and realistic models and enhance management planning.

Table 11.1. Summary of ESBS research conducted on factors responsible for the decline of striped bass in Chesapeake Bay (from ESBS 1988, Draft)

Hypothesis	Research	Summary
Contaminants	In-situ and On-Site bioassays in Maryland spawning rivers: Nanticoke 1984-87 C&D Canal 1985-87 Choptank 1987 Potomac 1986	Toxic conditions in some rivers in some years. No single contaminant is consistently responsible for mortality.
	Laboratory experiments pH, aluminum and metals for various life stages.	Highly sensitive to pH below 6.0 and aluminum concentrations. Salinity and organic acids ameliorate effects.
Starvation	Laboratory studies	Limited evidence of impact except perhaps in Potomac River.
Fishing Mortality	Extensive management changes. Simulation modeling.	Strong evidence of over-exploitation that reduced recruitment. Will mask other factors.
Predation/ Competition (Larval Stage)	Exposed larvae to variety of predators in laboratory.	Numerous potential predators but evidence in field data is lacking.
Climatic Events	Evaluated historical data on pH trends in major spawning rivers.	No evidence of systematic decrease in pH or increased frequency of low pH events. Historical information is insufficient to detect small changes.
Water Use Practices	Evaluated flow conditions in vicinity of C&D Canal.	Evidence of transport out of Bay and entrainment of larave. Overall impact is uncertain.
Disease	Laboratory studies of IPN virus	Nonlethal, but striped bass can act as carriers. Potential disease problems in intensive culture but much lesser problem in nature.

2. Studies of Relative Stock Size

Estimates of abundance of each striped bass stock contributing to the coastal migratory population would permit the development of a unified juvenile index as well as coastal harvest quotas. Research into methods for establishing relative or absolute stock sizes would be valuable.

3. Hook and Release and By-Catch Mortality

Restrictions on recreational and commercial harvest have been identified which are intended to achieve specified fishing rate (F) goals; F values have been selected which will allow sustainable harvests and ensure that stocks will continue to grow or remain at healthy levels; hook and release and by-catch mortality could contribute to higher effective F values than targeted, which could in turn result in stock declines; in addition, these mortalities result in a loss of fish with no benefit to man or to the stock; information is needed on the magnitude of these mortalities, factors which influence their magnitude, and means of reducing or eliminating this source of mortality.

4. Refinement of Techniques for Measuring Model Parameters

The management planning process which has been used to develop this plan has been heavily dependent on population models developed and exercised by the USFWS, Maryland DNR and Connecticut Department of Environmental Protection; data sets used to compute required parameters of these models have often been collected in programs not intended for that purpose; thus, parameter estimation and approximation has often been necessary to satisfy model needs; population studies need to be implemented or modified so that critical model parameters can be precisely and accurately quantified.

5. Stock Identification

This area of research continues and is of vital importance for developing management regimes which take into account multiple striped bass stocks; management approaches currently employed use only the Maryland Chesapeake Bay stock as the target stock; in the absence of a means of distinguishing Maryland fish from those from the Hudson, consistent and appropriate restrictions on harvest are often difficult to delineate.

6. Studies of Early Life Stage Processes

It is generally believed that processes occurring during early life stages (egg to juvenile) are extremely important in determining ultimate yearclass success; should definitive, deterministic relationships be established from which to characterize these processes, their application may allow more precise management measures to be taken.

7. Contaminant Effects and Habitat Degradation

ESBS continues to pursue this area of research, since environmental contaminants may be playing a role in depressing reproduction of striped bass in some areas; identification of specific contaminants and contaminant mixtures which adversely impact reproductive success may lead to water quality management strategies and measures which will contribute to the protection and enhancement of striped bass stocks. Contaminants represent only one factor adversely impacting on striped bass habitat. Consequences to stocks from wetlands alerations are also of interest.

Recommendation 9. All agencies which fund striped bass research and studies should use the priority listing of data needs presented above for guidance in the funding of specific research projects; results of such projects should be provided as soon as possible to ASMFC management groups to ensure that they are immediately available to enhance overall striped bass management efficacy.

12. INSTITUTIONAL REQUIREMENTS

The adaptive management approach used in this management plan requires extensive analysis and integration of data, interpretation of findings, and decision making based on those findings, on a regular and consistent basis. Thus, procedures employed for other ASMFC management plans upon their completion are not compatible with this plan.

The monitoring program required for plan implementation ensures that necessary technical information will be collected and analyzed. However, the results of these diverse studies conducted by many different agencies and states must be integrated in order to make the semi-annual stock assessments required by this plan. Based on history of the striped bass planning process over the past several years, it is evident that ASMFC must serve as the focal point for integration of these findings, with the technical support of states, agencies and contractors. However, funding of the planning process has to date been irregular and inconsistent, with no assurance from year to year that funds would be available to continue the process. Such a situation cannot continue after plan implementation, since the failure to acquire sufficient funding to continue the program in any given year will lead to the evolution of inconsistently regulated striped bass fisheries, with adverse and unacceptable impacts on the stocks.

Thus, ASMFC must formally establish a funding process which will ensure continuity of the monitoring and review elements of this management plan. Implementation of this plan will also require that the responsibilities and technical level of activities conducted by the ASMFC Advisory Committee be enhanced; this may require some modification of procedures and structure of that group. It may also be desirable to develop memoranda of understanding between state and federal agencies and ASMFC to formalize the committments which must be made to ensure successful striped bass management; such a procedure is employed in the management of migratory waterfowl.

Difficulties encountered while implementing the various amendments to the existing management plan demonstrate that state agencies which presently do not have reglatory authority over striped bass harvest should make every effort to acquire such authority. The need for prompt action on modifications to fisheries regulations in the future will make it very difficult for states not having authority to comply with ASMFC plan recommendations.

Management Action 18. An ASMFC Striped Bass Technical Committee will be established and will consist of striped bass technical specialists from each coastal state from Maine to North Carolina, Potomac River Fisheries Commission, and District of Columbia, as well as from USFWS and NMFS. Committee meetings will be held every 6 months to review technical information acquired during intervening time periods, and, at least every two years, the committee will integrate and interpret the findings to determine if management plan triggers and fishing rates are being met; should deviations from plan triggers and target rates be identified at any time, necessary changes in management regimes will be identified and presented to the ISMFP Policy Board for review and action. It shall be the goal of the monitoring and analysis program to develop a preliminary estimate of the rate of exploitation within 1 year of the fishing period in which the exploitation occurred.

Management Action 19. All state and federal agencies participating in the striped bass management program shall cooperate to develop secure long-term funding for implementation of the plan; a funding plan should be developed within 1 year of acceptance of this plan by the Commission under the direction of Chairman of the Commission.

13. PLAN IMPLEMENTATION

This management plan specifies a number of requirements with which individual states must comply before implementing harvest regulations specified here. In particular, states must have in place approved stock and harvest monitoring programs described in Section 7 before they will be permitted to establish fisheries. In addition, commercial fisheries seasons intended to achieve transition fishing rates must be identified and accepted. Because submittal and approval of these plan provisions will require some period of time, regulations to be in effect while moving from harest regulations in effect under Amendment 3 of the existing ASMFC Interstate Striped Bass Management Plan to the regulations proposed in this plan must be identified. The management actions presented below address the transition schedule and interim regulations.

Management Action 20. This amendment will become effective following its adoption by the Commission. Harvest regulations, as approved by ASMFC subject to Amendments 2 and 3 of the existing plan and which are in place in each state at the time of adoption must remain in place in each state until approval of final plan provisions for that state is obtained.

Management Action 21. Approval of final plan provisions, including transition commercial fishing seasons and monitoring plans, during the period of plan implementation will be by the existing Striped Bass S&S Committee and Management Board, until such time that all states' final plan provisions have been approved. Plan review and approval authority will at that time pass to bodies identified in Management Action 18.

14. REFERENCES

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APPENDIX A

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APPENDIX B

ACRONYMS

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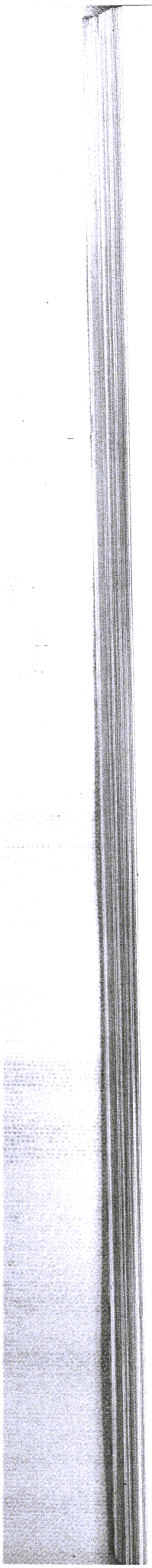
ACRONYMS

ASMFC - Atlantic States Marine Fisheries Commission
CRC - striped bass population dynamics model developed and applied by Dr. Victor Crecco
CWT - coded wire tags, being inserted in hatchery-reared striped bass released in the wild
DDFW - Delaware Division of Fish and Wildlife
DRBC - Delaware River Basin Commission
ESBS - Emergency Striped Bass Study, funded by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service
F - instantaneous fishing rate; an exponent in a population dynamics equation
FDA - U.S. Food and Drug Administration
FWS - striped bass population dynamics model developed and applied by Drs. Paul Rago and Robert Dorazio
IPN - infectious pancreatic necrosis virus
ISFMP - ASMFC Interstate Fisheries Management Program
JI - juvenile index; catch per unit effort of juvenile striped bass
M - instantaneous natural mortality rate; an exponent in a population dynamics equation
MDMR - Maine Department of Marine Resources
MdDNR - Maryland Department of Natural Resources
MDMF - Massachusetts Division of Marine Fisheries
MRFS - NMFS Marine Recreational Fishing Survey
NCMF - North Carolina Division of Marine Fisheries
NJMFA - New Jersey Marine Fisheries Administration
NMFS - National Marine Fisheries Service
NYDEC - New York Department of Environmental Conservation
NPDES - National Pollutant Discharge Elimination System
PCB - polychlorinated biphenyl; a cancer-causing contaminant
PRFC - Potomac River Fisheries Commission
RIMF - Rhode Island Division of Marine Fisheries
S&S Committee - ASMFC Scientific and Statistical Committee
USFWS - United States Fish and Wildlife Service
VIMS - Virginia Institute of Marine Sciences
VMRC - Virginia Marine Resources Commission
YOY - young-of-year (juvenile) striped bass
Z - instantaneous total mortality rate; an exponent in a population dynamics equation



APPENDIX C

DEFINITIONS

APPENDIX C

DEFINITIONS

ANNUAL (or seasonal) TOTAL MORTALITY RATE: The number of fish which die during a year (or season), divided by the initial number.

BIOMASS: The weight of a fish stock, or of some defined portion of it.

INSTANTANEOUS RATES: logarithmic, exponential, or compound-interest rates; for example, in the equation,

$$N_t = N_o e^{-zt}$$

N_t = the number of fish left at time t

N_o = the number of fish present at the beginning time, o

Z = the instantaneous total mortality rate; total mortality rate is the sum of the instantaneous fishing mortality rate (F) and the instantaneous natural mortality rate (M)

To convert these instantaneous rates into an annual percentage loss of fish (as represented by $1 - N_o/N_t$), a natural mortality rate is assumed (for striped bass, it has been assumed that M = .2), and the expected F is entered into the equation. The calculation of the equation with F =.25 and M = .2 (with Z then equal to .45) results in the annual percentage loss of fish being 36%; that is, the number of fish left at time t, (one year) is only 64% of the number of fish that were present at the beginning of the time period, time o.

NATURAL MORTALITY: Deaths from all causes except man's fishing, including predation, senility, epidemics, pollution, etc.

RECRUITMENT: Addition of new fish to the vulnerable population by growth from among smaller size categories.

STOCK: The part of a fish population which is under consideration from the point of view of actual or potential harvest and utilization.

YEAR-CLASS: The fish spawned or hatched in a given year. In the northern hemisphere, when spawning is in autumn and hatching in spring, the calendar year of the hatch is commonly used to identify the year-class (except usually for salmon).